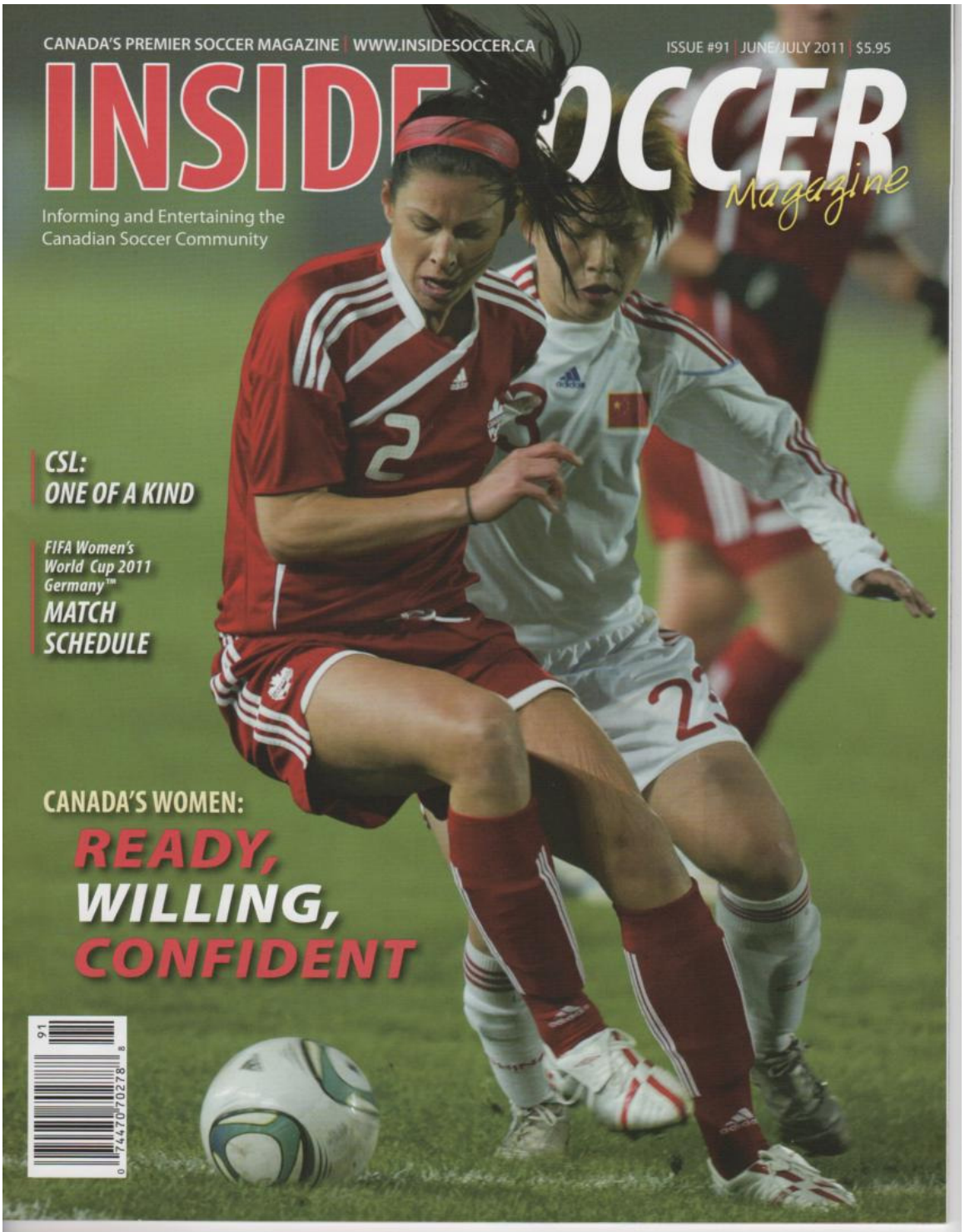
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RESISTED SPRINTING METHODS— Which One is Best?

By Richard Bucciarelli

Another of the exciting new training methods offered at the Soccer Fitness Training Centre is resisted sprint training, done using our unique Running Cords, which use an elastic loading device to apply resistance to the thighs and shins while running. Over the past 20 years, several different training methods have been used by fitness trainers and strength and conditioning coaches, to try to add resistance to running and sprinting movements. The purpose of this article is to examine the science behind different types of resisted sprinting training methods, and determine which are more or less effective in improving running speed.

Before such a comparison can be made, it is important to understand that there are two fundamentally different phases of high speed running, to which resistance can be added (each of which have their own specific biomechanical properties):

1. sprint starts / acceleration

During sprint starts, the body is trying to produce as much power as possible, from a static position. The athlete's body must be positioned so that the pelvis is tilted forwards, in a way that lowers the centre of mass, which allows for maximal power output and explosive forward movement. Forces from the legs must be directed backwards, and into the ground at a 45 degree angle, in order to propel the body forwards / upwards at a 45 degree angle.

2. upright running / striding

During upright running, there is less forward lean, and the body's centre of mass is more stable and upright. Propulsive forces are maximized by powerful hip flexion (raising the knees) and hip extension (pushing into the ground). The pelvis should not be tilted forwards, as this will limit the range of motion of hip flexion and decrease stride length, also decreasing running speed.

In this article, we are examining 3 different resisted sprinting methods, each of which provide resistance to sprint starts, upright running, or both:

1. Weighted Sleds
2. Parachutes
3. Elastic Loading Devices, or Running Cords

1. Weighted Sleds

As mentioned previously, an athlete starting a run / sprint from a static (motionless) start, has to be able to maximize the force they produce in the forward direction. Staying "low", tilting the pelvis and trunk forwards, will allow the athlete to produce maximal amounts of horizontal, or forward, forces. For this purpose, a properly designed harness affixed to a weighted sled, or loading device, can be an effective training tool for improving explosiveness in the first 3-5 steps of a maximal sprint effort. Weighted sleds lose their effectiveness if used for distances greater than 5-8 metres, or 3-5 steps, because they require the athlete to maintain a low centre of mass, and a forward-tilted pelvis. As mentioned previously, this type of body position will limit the range of motion of hip flexion (raising the knees) thereby reducing stride length. Having athletes train and run with resistance, using improper form such as a forward-tilted pelvis, can be counterproductive, as gains in strength may be offset by detrimental changes in running mechanics.

2. Parachutes

Parachutes used for resisted sprinting typically attach to the athlete's waist. While the athlete is in stride (upright running), parachutes apply a slight resistance at the waist, requiring the athlete to produce more horizontal (forward) propulsive forces. There are two inherent problems with using parachutes as resisted sprinting devices, however. Firstly, parachutes typically do not fill with air until the athlete has already reached an upright running posture. This means that they provide no resistance at the starting phase of sprinting (sprint starts). The second problem with parachutes is that, like weighted sleds or harnesses, they typically attach to the athlete's waist or torso. Once resistance from the parachute kicks in, this attachment site of the resistance means that the athlete must tilt the pelvis forwards to optimize the production of horizontal propulsive forces. As with weighted sled running, a forward-tilted pelvis is neither safe nor effective as athletes reach higher running speeds. The gains in strength caused by the slight resistance during upright running may be offset by decreases in mechanical efficiency caused by the forward-tilted pelvis.

3. Elastic Loading Devices, or Running Cords

Utilizing technology originally developed in the early 1990's by John Frappier of the Frappier Acceleration Program, elastic loading devices such as Running Cords provide elastic resistance to key muscles of the running stride (hip flexors, knee extensors, and lower abdominals) during the "swing phase" or sprinting. The cords attach to both the thigh (upper leg— provides resistance to hip flexion) and calf (lower leg — provides resistance

to knee extension) of both legs. This unique attachment site of resistance (to the athlete's legs) as opposed to the traditional attachments to the waist or torso with sleds and parachutes, allows for resistance to be added to the running stride without changing or affecting running mechanics. The pelvis is freely allowed to tilt forwards during sprint starts, thereby allowing the athlete to run with resistance from a static start. The resistance does not cause the pelvis to tilt forwards during upright running, allowing the athlete to maintain a high amount of hip flexion, and perform upright running with resistance at any speed. Because the load is applied mainly to the hip flexors and core muscles, running cords are the only resisted sprinting tool that effectively apply resistance to both the start, and upright, phases of sprinting.

Recent Research Involving an Elastic Loading Device:

In a 1997 study conducted through the Department of Exercise Science at the University of Massachusetts in Amherst, MA, Swanson et. al. used an elastic loading device to add resistance to hip flexion and knee extension during the "recovery" or "swing" phase of sprinting. Seven (7) male track and field athletes performed five trials in three (3) different locomotion conditions: 1. level running; 2. incline running at 30% grade and 4.5 metres/second; and 3. incline running at 30% grade, 4.0 metres/second and using the elastic loading device. Muscular loading was measured at the thigh and leg during all three conditions. The results indicated that the general patterns of muscle loading were the same for all three conditions. When comparing incline running (condition 2) against incline running with an elastic loading device (condition 3), the elastic loading device produced substantially greater muscular loading during the "recovery" (swing) phase during hip flexion (raising the knees).

Implications for Soccer Players

In soccer, as in many other "ground-based" sports, running speed, as well as the ability to recover between high intensity running (speed endurance), are both important aspects of physical performance. Because hip flexor strength can be a limiting factor in overall running speed, training methods that can increase hip flexor strength and power will have a positive effect on running speed and speed endurance, will also have a positive effect on improving physical performance in soccer. Training with elastic loading devices on an inclined treadmill has been shown to increase the muscular load to the hip flexors while running, while maintaining the same general pattern of muscular loading as is seen with level running.

This type of training, therefore, will allow soccer players to increase the strength and explosiveness of the hip flexors, and thereby improve running speed and speed endurance, while maintaining proper running mechanics. There is simply no other way to achieve this training effect than with elastic loading devices.

Richard Bucciarelli is the President of Soccer Fitness Inc., a soccer-specific strength and conditioning company from Toronto. For more information about Soccer Fitness Inc., visit www.soccerfitness.ca.